UNIVERSITY of GUELPH

BINF*6210 Software Tools for Biological Data Analysis and Organization

Fall 2022
Section(s): C01

College of Biological Science
Credit Weight: 0.50
Version 1.00 - September 08, 2022

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1 Course Details

1.1 Calendar Description

This course familiarizes students with tools for the computational acquisition and analysis of molecular biological data. Key software for biological data acquisition, management, analysis, and visualization are presented. Laboratory exercises guide students through application of relevant tools.

1.2 Course Description

Welcome Message: Welcome to BINF*6210! We look forward to working with you this semester. We greatly enjoy teaching this course, as students make such a large leap forward in just one semester in their ability to program and to conduct bioinformatics analysis on real biological data. Despite the hybrid nature of the course we are able to maintain a highly interactive structure of this course. Our students regularly "do things" rather than only listen. The best way to learn how to do bioinformatics analyses is to do bioinformatics analyses!

Overview: The main goal of this course is to guide graduate students through an introduction to the analysis of biological data using computational and statistical tools, with emphasis upon the analysis of molecular biology data. The course will largely focus upon developing programming skills in the R language for quality checking, analyzing, and visualizing data. The course also includes an introduction to several key web-based tools. We also will cover how to acquire and analyze data from selected biological databases important for bioinformatics, including sequence databases such as NCBI and BOLD, biodiversity databases, and functional gene annotation resources. It is important to recognize the origins and limitations of these data in addition to their utility. We will discuss core bioinformatics algorithms (e.g. for alignment, clustering, phylogenetics) and population genetics metrics and principles that are important for making analytical decisions and interpreting results. We also will promote good practices for organizing your data and analyses, preparing reproducible analyses, and

writing well-commented code, and will introduce software tools that facilitate version control and collaborative coding. As bioinformatics is a fast-moving discipline, we will also spend time practising strategies for how to learn to use new tools and to conduct new analyses.

Curriculum Note: This course is complementary to others in the bioinformatics graduate program. In the fall semester of 2022, programming in the Unix environment and in the Python language are covered in Bioinformatics Programming (BINF*6410). Students in the Master of Bioinformatics program must also take Topics in Bioinformatics (BINF*6890), which covers diverse concepts in bioinformatics and emphasizes critical thinking and communication skills. Key topics for this year include molecular phylogenetics, statistics, and proteomics. The winter semester core bioinformatics courses are Genomic Methods (BINF*6110), in which large-scale genomic analysis and high-performance computing are covered, and Statistical Bioinformatics (BINF*6970). Students from other graduate programs may wish to discuss their background and the suitability of these courses with the instructors prior to enrolling.

Pre-Requisites: Students accepted into the Master of Bioinformatics and MSc in Bioinformatics programs should have the necessary background for this course. While programming experience (in any language) is helpful, no prior programming experience is assumed. Students are expected to have taken at least one course at the undergraduate level in genetics or molecular biology as well as at least one course in statistics or biostatistics (or have the equivalent experience).

Course Format: This course will be held in person with a hybrid options unless otherwise decided by public health and the university administration. For the hybrid part we will be using using Zoom so that students can join, whether in class or remotely, regardless of their personal circumstances. Recordings of class will be made available but given the interactive nature of the course just listening to those will not suffice for this course. These are meant to repeat certain concepts on your own or if you miss a single class.

1.3 Timetable

Where: Instruction will commence in SSC2315 on Sep 13, with Zoom access instructions provided through the CourseLink site.

When: Tuesdays and Thursdays 11:30 AM - 12:50 PM Eastern time.

(Note: There is no class on Tuesday October 11 for the Fall Study Break.)

1.4 Final Exam

There is no final exam for this course.
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2 Instructional Support

2.1 Instructional Support Team

Instructor:	Dr. Dirk Steinke Adjunct Professor, Department of Integrative Biology
Email:	dsteinke@uoguelph.ca
Telephone:	+1-519-824-4120 x53759
Office:	CBG109
Office Hours:	Office Hour: please get in touch via email and we can arrange a time

For the benefit of all class members, I encourage students to ask questions during class time and to post general questions about course content and the assignments to the Discussion board through CourseLink.

2.2 Teaching Assistants

Teaching Assistant (GTA):	Jessica Castellanos Labarcena PhD Candidate. Arrell Scholar
Email:	jcaste01@uoguelph.ca
Office Hours:	Students will benefit from interaction and instruction from Teaching Assistant Jessica Castellanos-Labarcena, a PhD student. Please email Jessica for an appointment.

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3 Learning Resources

3.1 Required Resources

R and RStudio (Software)
Prior to the first class, please install R on your computer:
https://www.r-project.org/

Prior to the second class, please install RStudio:
https://www.rstudio.com/

Announcements will be made throughout the semester regarding R packages or additional software to install prior to the next class.

Papers and Textbook Chapters (Readings)
Relevant published articles related to the course content for each day will be posted through CourseLink. The first-listed article for each class is **required reading for that class**. The other posted readings are recommended or supplemental for students interested in more depth on that topic.

We will also be consulting a wide range of online resources, such as software manuals and

vignettes for Bioconductor packages. Links to relevant resources will be posted in the class slides and in the comments sections of the example code.

Additionally, selected chapters from the following manuals and books will be recommended to accompany specific modules. All are available as open-access PDFs directly online or are available as a PDF book for download through the University of Guelph library site (https://www.lib.uoguelph.ca/).

1. Paradis E, 2005. R For Beginners. (Freely available through the following link: https://cran.r-project.org/doc/contrib/Paradis-rdebuts_en.pdf)

2. Wickham H & Grolemund G, 2017. R for Data Science. O'Reilly. (Freely available through: http://r4ds.had.co.nz/)

3. Xia X, 2018. Bioinformatics and the Cell: Modern Computational Approaches in Genomics, Proteomics and Transcriptomics. Second Edition. Springer. (Available through the library)

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4 Learning Outcomes

4.1 Course Learning Outcomes

By the end of this course, you should be able to:

1. • obtain data from key databases relevant for bioinformatics and to understand the sources and limitations of these data.

2. • filter, manipulate, analyze, and visualize bioinformatics data, with emphasis on the R programming language and software resources available through Bioconductor.

3. • conduct reproducible analyses and use software tools for version control and collaboration.

4. • understand and apply selected algorithms commonly used in bioinformatics, including for sequence alignment and clustering.

5. • adapt the above skills to learn new tools and conduct new analyses not

explicitly covered in class.

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5 Teaching and Learning Activities

5.1 Lecture

Thu, Sep 9 - Thu, Dec 2

Topics:	This course consists of both asynchronous components (which you complete at your own pace in advance of class) and synchronous activities (i.e. conducted during our scheduled class time).
	Each week, course materials will be uploaded to CourseLink for students to complete in advance of class. This will typically include a pre-recorded lecture or tutorial. Many weeks, there will also be one or two commented R scripts provided for students to go through at your own pace. There is also a required reading associated with each class.

5.2 Lab

Topics:	The course also involves synchronous activities performed during class time (11:30 AM - 12:50 PM Tuesdays and Thursdays from Sept 13).
	During class time, after a short introduction, we will focus upon interactive learning activities, including critical thinking exercises, solving coding challenges, and sometimes even games. During many of the classes, we will use technology to form small "break-out groups" to enable small groups to work together for selected active learning exercises, with the Instructor and Teaching Assistant rotating among groups. We then come together again as a complete class to discuss the exercise and to address questions from class members.

5.3 Topics

You will find here the planned schedule of topics. Minor adjustments may be made throughout the semester, such as based upon the background and interests of class members or prospects for an interesting guest lecture. Any changes would be announced through CourseLink.

1 - Sept 13 - Introduction to Course and R

2 - Sept 15 - RStudio and DNA barcoding

3 - Sept 20 - BOLD and Biodiversity

4 - Sept 22 - R Tips and Data Frames 1

5 - Sept 27 - Data Frames 2

6 - Sept 29 - Intro to tidyverse and R Game

7 - Oct 4 - Graphing and ggplot2 package

8 - Oct 6 - Bioconductor Biostrings k-mers

9 - Oct 13 - R Markdown - randomForest

10 - Oct 18 - Databases NCBI

11 - Oct 20 - Sequence Alignment

12 - Oct 25 - Clustering

13 - Oct 27 - Phylogenetics

14 - Nov 1 - GitHub

15 - Nov 3 - Iteration Looping Pipelines

16 - Nov 8 - Writing Functions in R

17 - Nov 10 - Gene Expression Analysis

18 - Nov 15 - Population Genetics

19 - Nov 17 - data.table package

20 - Nov 22 - Microbiome

21 - Nov 24 - Imputation

22 - Nov 29 - Relational Data and SQL

23 - Dec 1 - Discuss Package Development and Course Synthesis

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6 Assessments

Overview: There are 4 major and 1 minor assignment for this course. Detailed instructions and a grading rubric for each assignment are posted to CourseLink. This course also includes a short weekly quiz to help you stay on track throughout the semester.

Plagiarism: Please note that the TurnItIn tool will be used to assess the originality of your work in comparison to that of your peers and to internet sources. If a high match to online sources is detected, please note that we would check to see where the matches are. We expect exact matches to other sources for the assignment questions, to the references (e.g. journal article titles), and phrases that should be used exactly as in sources (e.g. long molecule names). Additionally, you are permitted to adapt provided example computer scripts for your assignments, but you should also add some novel code. The amount of novel code will increase throughout the semester. You should explain the commenting in your own words (what is your code doing and why are you doing it). Otherwise, be sure to phrase your work in your own words, and be sure to give credit to others for ideas from the literature as well as to any online sources consulted for coding help.

Quiz Grading and Due Dates: Missed quizzes will receive a grade of 0, and your best 10 of 12 quizzes will be used for your quiz grade. There is no extension on quizzes unless of exceptional circumstances influencing your academic performance for two or more weeks. Such exceptional circumstances must be discussed with the instructor. It is to your advantage to attempt each quiz and learn along the way.

Assignment Due Dates: Please submit your assignments to the labeled Dropbox folder by the due date and time. The course instructors recognize that the pandemic has caused challenges for many individuals, whether due to personal health, familial responsibilities, etc. Therefore, if you find that you cannot meet a deadline for an Assignment due to illness or compassionate reasons, please contact the instructor to discuss your situation **prior to the deadline date (unless something beyond your control makes this impossible)**.
No late penalty will be imposed **in this case**, and the instructor will discuss your situation with you and what academic accommodation may be suitable.

Final Project Due Date: Please note that the final project due date is a **hard deadline** for receiving a grade for this course for the Fall 2021 Semester. This due date was selected to give you time to work on your project. Aim to complete a full project draft at least two days in

advance, and spend the last days on proofreading and refinement. If you need to miss this deadline due to illness or other exceptional personal circumstances, documentation needs to be provided and you will receive a grade of INC (incomplete). Depending upon your individual circumstance, we would then work together to set a revised due date, and you would receive your final course grade in the Winter 2022 semester.

Learning through Doing: In this course, assignments are used not only for assessment. The assignments are also designed to serve as important learning tools. You should work on your assignments regularly. Do not leave these assignments to the night before the due date! We hope that you enjoy working on a variety of small yet meaningful projects throughout the course and expressing your creativity.

6.1 Assessment Details

Weekly Online Quizzes (20%)

Throughout the semester, there will be a weekly online quiz, available through CourseLink. Quizzes will cover topics such as key terms, concepts, and code syntax. There will be 12 quizzes in total, and your best 10 will be used to calculate your quiz grade (2% valuation each). While each quiz bears modest weighting, we encourage all class members to keep up with the quizzes as they will add up to 20% of your total course grade, and grades in the project assignments are typically lower. Moreover, making a consistent weekly effort will help you to improve your knowledge and skills consistently throughout the semester and avoid stress at the end. You should view the pre-recorded course materials, read the reading, and attend class prior to attempting each week's quiz. These are "open book" quizzes. While completing the quiz, you may therefore consult all course materials as well as online sources. You may complete each weekly quiz at your own pace, any time before the due date (5:00 PM Mondays). Quizzes not completed by the due date will receive a grade of 0 but will remain available for viewing. Whenever possible, we encourage class members to complete the quiz on Thursday after class or on Friday each week.

Quizzes should be completed by 5:00 PM Eastern Time on Mondays, preferably earlier.

Assignment #1 (15%)

Date: Fri, Oct 8, 5:00 PM

For assignments #1 and #2, you will apply your knowledge to solve new problems. You will design and complete a mini-project that builds upon the skills and concepts covered until that point in the course. Example mini-projects will be provided.

Code needs to be correct, do what it is meant to do (always check!), be well-commented, and reproducible. In your commenting, you should focus on being precise in your explanations of algorithms and functions.The assignment will include an introductory paragraph and a short written summary at the end interpreting your findings. For this assignment, you may, in part, correctly adapt provided example scripts. You will additionally be assessed on the creativity and novelty of your mini-project in terms of going

beyond the class materials.

Throughout the semester, you will need to balance your time between courses. Each assignment for Software Tools should be worked on regularly over a couple of weeks. Do not leave these assignments to the night before!

Assignment #1 is due to the CourseLink Dropbox by 5:00 PM by Friday Oct. 7th.

Assignment #2 (15%)
Date: Fri, Oct 29, 5:00 PM
See above for the description of Assignment #1.

Additionally, as the course progresses, you should aim to write code that is streamlined as well as computationally efficient. Examples would include using vectorized functions in R rather than repeating similar lines of code. You should also pay careful attention to the preparation of your visualizations, considering whether the main message is conveyed clearly, ensuring that you have used informative labeling, checking that your colour and symbol choices are clear and accessible, etc. The quality and sophistication of your work will improve over the course of the semester.

Assignment #2 is due to the CourseLink Dropbox folder by 5:00 PM by Friday October 28th.

Assignment #3 (Group Project) (15%)
Date: Fri, Nov 19, 5:00 PM
For Assignment #3 (Group Project), you will swap code (from either Assignment #1 or Assignment #2) with a peer in your group. The assignment involves making improvements to your peer's code and using GitHub to manage the collaboration and code edits. You should discuss the project together and may work on the code together. Each person will individually prepare a short-write up about the code improvements and collaboration process, which is individually graded.

(Why GitHub? GitHub is an important code repository as well as a tool for version control and collaboration. By the end of your program, we would highly recommended that you post examples of your work to GitHub and provide a link to your GitHub page on your CV when applying for bioinformatics-related jobs.)

Assignment #3 is due to the CourseLink Dropbox folder by 5:00 PM by Friday November 18th.

Assignment #4 (Seminars) (5%)
Date: Fri, Dec 3, 5:00 PM
For students registered in the Software Tools class, attendance at the Bioinformatics Seminar Series is mandatory. Seminars will be held in virtual format for the Fall 2021 semester. Attendance in real time is preferred to the maximum degree possible, to enable audience members to ask questions and to interact with members of the community afterwards. However, the seminars will be recorded for those who need to watch at a

different time due to illness or personal circumstances. The seminar series will help you to expand your knowledge of the field of bioinformatics as well as increase your exposure to the diversity of careers possible.

Students should attend all seminars of the F21 semester. There are typically 3-4 seminars per semester. You will then choose any two seminars for this short writing assignment.

Assignment #4 is due by 5:00 PM to the CourseLink Dropbox by Friday December 2nd.

Assignment #5 (Final Project) (30%)
Date: Fri, Dec 17, 5:00 PM
Assignment #5 involves completing a final course project consisting of written paragraphs interspersed with commented code blocks and visualizations. Your project should include: introduction, description of dataset, data exploration and quality control (commented code block and visualizations), description of main software tool used, main
analyses (commented code block and visualizations), interpretation of results and discussion.

Several example topics will be provided. If you wish to choose your own topic, you may do so only if you obtain approval from the instructor at least three weeks before the due date. Your project must incorporate at least one software tool beyond those covered in class. Being able to read software documentation and do new analyses of interest to you is important in bioinformatics. Where relevant, you may adapt aspects of example scripts from class, but for the final project it is also essential to include some novel code, such as writing your own function.

Assignment #5 is due to the CourseLink Dropbox folder by 5:00 PM by Friday December 16th. Please note that this is a hard deadline for receiving a grade this semester, so aim to submit early.

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7 Course Statements

7.1 Class Attendance

Class attendance, whether in remote format or in class, is considered mandatory for Software Tools. While pre-recorded lectures and tutorials will be provided, participation in the synchronous learning activities during class time will help you to maximize your success in the course and beyond.

Instructor-led course presentations will be recorded. However, please note that small break-out groups of students will not be recorded. Therefore, it is best to attend class synchronously. If you do need to miss a class, please go through the recorded components and also work through the commented example scripts and coding challenges posted to CourseLink. Also, review the example answers, once posted.

Throughout the semester, you should regularly consult CourseLink for announcements and posted course materials.

7.2 Group Activities

Throughout the course, we will engage in regular discussions and coding activities in pairs or small groups during class time. Pedagogical research indicates that you will learn better if you regularly work in groups and engage in active learning activities. So, please come to the (virtual) class prepared to engage with your peers.

We will change up the groups regularly so that you can meet new people and work with individuals with varying personalities and academic backgrounds. Collaboration is common in bioinformatics in the workplace as well, and so this is good practice for your career beyond graduate studies.

We also encourage students to form peer study groups to review course materials outside class time and to engage in other activities beyond the course materials, such as analyzing additional datasets to develop your skills further. You may also work together to solve the "coding challenges" posed to you. Taking the time to work through problems of increasing difficulty will help you to improve.

For graded assignments, it is important to complete your work yourself. You may discuss your work class peers, but "copy/paste" is not permitted. Type the solution on your own. If someone helps you to solve a problem, it is essential to provide an acknowledgement at the end of your assignment. For the group assignment, you should discuss your assignment in depth and can work together on the code. Each person submits an individual short write-up, which is graded individually. You need to prepare your own written remarks for all assignments.

7.3 Course-Specific Statement on Academic Integrity

You are encouraged to work in peer groups to practise your coding skills, to discuss concepts, and to seek advice about useful software and information resources. However, you must complete your individual assignments yourself. You may discuss your work with others but must not copy/paste from peers and must provide an acknowledgement to for any help received. Electronic resources (such as TurnItIn) will be used to assess the originality of your assignments. Use quotations sparingly, such as for profound statements or definitions. Otherwise, you should paraphrase from any sources you cite for the written portions of your assignments. You are free to consult online resources to learn about various ways of coding and approaching bioinformatics problems. If you draw heavily from a specific source (such as a particular entry on Stack Overflow) when completing an assignment, then you should cite that source and indicate how you adapted the code for your purposes. You always need to check that your code works as intended.

You will work together in a small group for one group assignment (assignment #3). You should discuss your assignment and may work on the code together. You should complete the short write-up for that assignment on your own. The assignment is graded individually.

Please see below for the university-level statement on academic integrity for further information.

8 College of Biological Science Statements

8.1 Wellness

If you are struggling with personal or health issues:

- Counselling Services offers individualized appointments to help students work through personal struggles that may be impacting their academic performance.
- Student Health Services is located on campus and is available to provide medical attention.
- For support related to stress and anxiety, besides Health Services and Counselling Services, Kathy Somers runs training workshops and one-on-one sessions related to stress management and high performance situations. http://www.selfregulationskills.ca/

8.2 Personal information

Personal information is collected under the authority of the University of Guelph Act (1964), and in accordance with Ontario's Freedom of Information and Protection of Privacy Act (FIPPA) http://www.e-laws.gov.on.ca/index.html. This information is used by University officials in order to carry out their authorized academic and administrative responsibilities and also to establish a relationship for alumni and development purposes.

For more information regarding the Collection, Use and Disclosure of Personal Information policies please see the Undergraduate Calendar. (https://www.uoguelph.ca/registrar/calendars/undergraduate/current/intro/index.shtml)

8.3 Course Offering Information Disclaimer

Please note that course delivery format (face-to-face vs online) is subject to change up to the first-class day depending on requirements placed on the University and its employees by public health bodies, and local, provincial and federal governments. Any changes to course format prior to the first class will be posted on WebAdvisor/Student Planning as they become available.

9 University Statements

9.1 Email Communication

As per university regulations, all students are required to check their e-mail account regularly: e-mail is the official route of communication between the University and its students.

9.2 When You Cannot Meet a Course Requirement

When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons please advise the course instructor (or designated person, such as a teaching assistant) in writing, with your name, id#, and e-mail contact. The grounds for Academic Consideration are detailed in the Undergraduate and Graduate Calendars.

Undergraduate Calendar - Academic Consideration and Appeals
https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml

Graduate Calendar - Grounds for Academic Consideration
https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml

Associate Diploma Calendar - Academic Consideration, Appeals and Petitions
https://www.uoguelph.ca/registrar/calendars/diploma/current/index.shtml

9.3 Drop Date

Students will have until the last day of classes to drop courses without academic penalty. The deadline to drop two-semester courses will be the last day of classes in the second semester. This applies to all students (undergraduate, graduate and diploma) except for Doctor of Veterinary Medicine and Associate Diploma in Veterinary Technology (conventional and alternative delivery) students. The regulations and procedures for course registration are available in their respective Academic Calendars.

Undergraduate Calendar - Dropping Courses
https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-drop.shtml

Graduate Calendar - Registration Changes
https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/genreg-reg-regchg.shtml

Associate Diploma Calendar - Dropping Courses
https://www.uoguelph.ca/registrar/calendars/diploma/current/c08/c08-drop.shtml

9.4 Copies of Out-of-class Assignments

Keep paper and/or other reliable back-up copies of all out-of-class assignments: you may be asked to resubmit work at any time.

9.5 Accessibility

The University promotes the full participation of students who experience disabilities in their academic programs. To that end, the provision of academic accommodation is a shared responsibility between the University and the student.

When accommodations are needed, the student is required to first register with Student Accessibility Services (SAS). Documentation to substantiate the existence of a disability is required; however, interim accommodations may be possible while that process is underway.

Accommodations are available for both permanent and temporary disabilities. It should be noted that common illnesses such as a cold or the flu do not constitute a disability.

Use of the SAS Exam Centre requires students to make a booking at least 14 days in advance, and no later than November 1 (fall), March 1 (winter) or July 1 (summer). Similarly, new or changed accommodations for online quizzes, tests and exams must be approved at least a week ahead of time.

For Guelph students, information can be found on the SAS website
https://www.uoguelph.ca/sas

For Ridgetown students, information can be found on the Ridgetown SAS website
https://www.ridgetownc.com/services/accessibilityservices.cfm

9.6 Academic Integrity

The University of Guelph is committed to upholding the highest standards of academic integrity, and it is the responsibility of all members of the University community-faculty, staff, and students-to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff, and students have the responsibility of supporting an environment that encourages academic integrity. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor.

Undergraduate Calendar - Academic Misconduct
https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml

Graduate Calendar - Academic Misconduct
https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml

9.7 Recording of Materials

Presentations that are made in relation to course work - including lectures - cannot be recorded or copied without the permission of the presenter, whether the instructor, a student, or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

9.8 Resources

The Academic Calendars are the source of information about the University of Guelph's procedures, policies, and regulations that apply to undergraduate, graduate, and diploma programs.

Academic Calendars
https://www.uoguelph.ca/academics/calendars

9.9 Disclaimer

Please note that the ongoing COVID-19 pandemic may necessitate a revision of the format of course offerings, changes in classroom protocols, and academic schedules. Any such changes will be announced via CourseLink and/or class email.

This includes on-campus scheduling during the semester, mid-terms and final examination schedules. All University-wide decisions will be posted on the COVID-19 website (https://news.uoguelph.ca/2019-novel-coronavirus-information/) and circulated by email.

9.10 Illness

Medical notes will not normally be required for singular instances of academic consideration, although students may be required to provide supporting documentation for multiple missed assessments or when involving a large part of a course (e.g.. final exam or major assignment).

9.11 Covid-19 Safety Protocols

For information on current safety protocols, follow these links:

- https://news.uoguelph.ca/return-to-campuses/how-u-of-g-is-preparing-for-your-safe-return/
- https://news.uoguelph.ca/return-to-campuses/spaces/#ClassroomSpaces

Please note, these guidelines may be updated as required in response to evolving University, Public Health or government directives.

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